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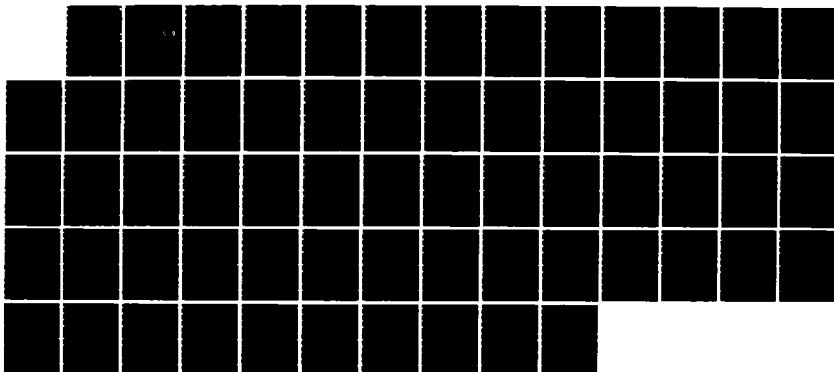
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THE KEY TO ENHANCING (U) ARMY COMMAND AND GENERAL STAFF  
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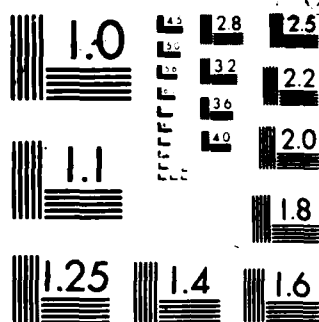
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Improving  
Light Infantry Divisional Engineer Agility--  
The Key to Enhancing Their Mission Capability

by

Major Frank P. Janacek  
Corps of Engineers

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APR 20 1987  
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School of Advanced Military Studies  
U.S. Army Command and General Staff College  
Fort Leavenworth, Kansas

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## ABSTRACT

IMPROVING LIGHT INFANTRY DIVISIONAL ENGINEER AGILITY-- THE KEY TO ENHANCING THEIR MISSION CAPABILITY by MAJ Frank P. Janecek, USA, 55 pages.

This monograph examines the light infantry division engineer battalion's agility. The factors and organizational elements that affect agility are discussed. Organizational weaknesses in the light engineer battalion are examined and changes that will improve agility are recommended.

The monograph first examines agility and develops an agility model used to assess the doctrinal capability of the light infantry division's engineer battalion. The monograph next examines historical experiences of infantry divisional engineers in World War II and selected reports and studies since then. Historical pitfalls in organizational design are mentioned. Then an analysis is made identifying common agility deficiencies and how they historically have been dealt with. From this analysis of historical experiences, conclusions are drawn that lead to a number of recommendations.

Finally, thirteen recommendations are presented that increase the agility of the light infantry division engineer battalion. The recommendations address training, personnel, equipment, and organization. They are prioritized by their impact on agility and strategic deployability. High technology improvements such as night vision devices, remote firing devices, exotic explosives, and computers and increased firepower are not addressed. Instead, recommendations focus on more traditional means to enhance agility.

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## I. INTRODUCTION

The reorganization of the engineer component in the infantry division in 1941 and 1942 appears to have been established on an arbitrary basis of an allowable percentage of engineers and not on an analysis of the engineer requirements.

BG MCCABE, Chairman, 1946  
Infantry Conference.

The August 1983 Army Commanders' Conference was a major milestone in force development for the US Army. The conference directed the Army of Excellence (AOE) study as a means to develop significant force changes meant to correct perceived deficiencies and create a light, division size, strategically deployable force to meet contingency missions. (1) The new light infantry division was to be fighter heavy, approximately 50% infantry, with nine maneuver battalions, and maintain the ability to deploy strategically using approximately 500 C-141 sorties. (2)

The impact of AOE force changes on the engineer community has been significant. Changes to engineer organizations have been made at every level, from division to echelons above corps. One of the changes was the creation of a light infantry division (LID) engineer battalion that would be strategically deployable, yet meet the essential combat engineer requirements of the light infantry division. (Figure 1)

In order to meet the strategic deployability requirements, the LID engineer battalion was significantly reduced in both personnel strength and equipment authorized. A comparison of three divisional engineer battalions is shown on Tables 1 and 2. The initial design of the light engineer battalion specified a strength ceiling of 264 and was designed to use fewer than 15 C141 sorties. It was designed with no construction mission requirement nor capability, and to

perform only the minimum essential general engineering tasks.(3) Instead of a broad combat support mission, addressing the major functional areas of mobility, countermobility, survivability and general engineering, the light engineers' design was focused only on mobility, countermobility and survivability.

Organizationally the engineer battalion was restructured. The three line companies were reduced to 64 men each and have only two platoons as opposed to the 164 man company with three platoons in the standard infantry division engineer battalion. Each company traditionally supported a maneuver brigade with platoons in direct support of maneuver battalions. The companies and platoons now support the light infantry brigades on an area basis. Engineer equipment which previously had been organic to the engineer companies is now concentrated in the headquarters company along with maintenance, supply, and other administrative functions. Engineer equipment is now allocated to companies for specific missions.(4)

Does this relatively small LID engineer battalion retain the agility to adequately accomplish its intended missions in support of the light infantry division? If not, what changes can be made to increase the battalion's agility and subsequent mission capability? This study will attempt to answer these questions. Through a review of current doctrine, a study of historical experience, and a comparison and analysis of the two, I will develop recommendations to increase engineer agility in an attempt to alleviate the current deficiencies, while minimizing the impact on strategic deployability.

## II. DOCTRINE

By doctrine I mean organization, control, assignment of appropriate ranks to officers, regulation of supply routes, and the provision of principal items used by the army.

Sun Tzu, THE ART OF WAR.

Before we can determine if the engineer battalion has the necessary agility to support the light division, we must identify what constitutes agility. FM100-5 defines agility as "... the ability of friendly forces to act faster than the enemy...such greater quickness permits rapid concentration of friendly strength against enemy vulnerabilities...In the end, agility is as much a mental as a physical quality". (5) For the Light Infantry Division "Agility is a function of the responsiveness and flexibility of commanders, units, and staffs as they respond to situations more rapidly than the enemy". (6) It is easy, as many people do, to confuse mobility with agility. However, it should be clear that agility has both psychological and physical components and is not just physical mobility on the battlefield.

Bill Lind's definition of maneuver has many of the attributes of agility and provides a good start in an attempt to develop the concept of Light Engineer agility. Let's say agility is the ability to think and act faster than the enemy and assume it is encompassed in the four time-competitive basic cycles of: observe, orient(plan), decide, act (OODA). (7) Mathematically we can express agility as the sum of the functions:  $Agility = f(obs) + f(orient) + f(decide) + f(act)$ . Thus, increases in the capability to accomplish any of the functions of agility will result in increased agility. To restate agility as a function of time we can say:  $t(agility) = t(obs) + t(plan) + t(decide) + t(act)$ . Our goal is to increase agility and reduce the total time from observation of a given situation to

completion of the desired action.

Common methods to increase the "observe" function and reduce the time are: Intelligence Preparation of the Battlefield (IPB), study and knowledge of the enemy, detailed map and/or ground reconnaissance, use of Standard Operating Procedures (SOP), reports, designated Essential Engineer Elements of Information (EEEI), and established indicators of probable actions.

Means to increase the ability to "orient and plan" and reduce the time it takes are: prepare Operations Plans (OPLAN), wargame, preplan materiel requirements, use SOPs, integrate operations with maneuver units, coordinate organic and nonorganic unit operations, and task organize.

Methods to increase the decision function normally include: wargame, increase the size of staffs, establish SOPs, use drills, rehearse and train leaders and staffs using command post exercises, staff exercises, tactical exercises without troops, simplify and speed communications, use computers to simplify redundant tasks, and more efficiently schedule work.

Approaches to increase the ability to "act" and at the same time reduce the time needed are: increase mobility, rehearsals, drills, SOPs, reduce travel and non-productive time, utilize more efficient equipment, improve physical fitness, ensure proper tools and equipment are available when and where needed, create larger units, and augment engineers with infantry or other support forces.

If we use this cycle to respond to situations more rapidly than the enemy we can out think the enemy and thus act faster than him. This is the heart of agility. The engineer organizational structure must be able to accomplish each cycle as efficiently as possible to

the resultant aggregate will be a response that is faster than the enemy's.

To improve an engineer organization's agility let's examine the responsible organizational components. The following matrix identifies a responsible staff section and some components of the agility functions. Each subordinate organization and component will have its own internal set of OODA factors that affect the aggregate time function.

FACTORS				
	<u>Observe</u>	<u>Orient</u>	<u>Decide</u>	<u>Act</u>
O	S2/companies	S2/S3/S4	CDR/Staff	Engr Co
R		ADE/Bde Engr	& Companies	Spt'g elem.
G				
A				
N C	see	plan	order	move
I O	communicate	evaluate	direct	execute
Z M	reconnoiter	integrate	coordinate	train
AaP	know area of	decide	communicate	maintain
TnO	opns	get feedback	compare	fitness
IdN	control		command	respond
O E	report		evaluate	equip
N N			rehearse	standardize
T			prepare	drill
S				practice

For the engineer battalion to improve its agility to support the light division, the staff must integrate engineer operations into division and brigade plans and then have engineer companies accomplish missions at an optimum work rate. Each section, by improving the speed and thoroughness with which it accomplishes the functions above, has the potential to improve engineer agility. We'll examine them in more detail later, but to conclude this discussion, it is important to remember that agility is based on responsiveness, flexibility, and integrated actions that shorten the response time while maximizing mission accomplishment.

The divisional engineer is a force multiplier whose doctrinal

mission is "to increase the combat effectiveness of the light infantry division, by accomplishing mobility, countermobility, and surviveability missions"(8) and conducting infantry operations when required. Doctrinally, general engineering and topographic missions have been assigned to echelons above the light division (EAD).(9)

The light engineer's doctrinal missions have not changed much from regular engineer tasks; however, the means to accomplish them have been significantly reduced. The doctrinal missions follow:

Provide "advice to the divisional commander and other maneuver commanders on all matters concerning the planning and execution of the engineer missions needed to support divisions operations. Plans, supervises and coordinates activities of assigned, attached and supporting engineer units engaged in mobility, countermobility, survivability, general engineering and topographic tasks. Conducts engineer reconnaissance and produces engineer intelligence information for the division".(10)

Doctrinally, mobility missions are:

"Prepares and maintains essential combat routes in the forward battle area to include ingress and egress to blocking positions and river crossing sites and expedient repair of essential bridges, fords, and culverts... Assists in the assault of fortified positions...Assists maneuver units in the assault breach of obstacles and minefields...Provides limited construction and repair of forward area landing strips, helipads, and forward area refuel and rearming points".(11)

Countermobility missions are:

"emplaces and assists in the manual emplacement of mines... creates other obstacles to degrade enemy mobility including berms, ditches, abatis and wire entanglements... plans, prepares and executes demolition targets such as the destruction of bridges and the cratering of roads, railroads and airfield runways".(12)

To support the survivability mission, the light engineer battalion "provides field engineering advice to all divisional elements and assistance and equipment support to maneuver units in preparation of selected strong points and fighting positions for weapons systems".(13) With six engineer platoons and one assault and barrier

platoon, it is easy to question the light engineer battalion's ability to accomplish this myriad of missions.

Engineer missions are intrinsically tied to terrain. The engineer observes, uses, prepares, improves, reinforces, clears, denies, and modifies the ground in support of divisional units. However, the engineer does not normally occupy the ground in the sense that the infantry does. The engineer unit receives its missions, moves to a location, and using handtools, equipment or explosives accomplishes a terrain modification that takes an amount of time and then moves to the next job site. This concept of moving about the battlefield, modifying terrain for others, implies that mobility is essential to engineer agility.

The LID engineer battalion is significantly smaller than other US divisional engineer battalions. Tables 1 and 2 summarize and compare the organizational framework and the major equipment items of the organic engineer battalions in the Armored/Mech Division, the Infantry Division, and the Light Infantry Division. Table 3 lists subordinate units and personnel strengths of the standard infantry and light infantry divisions.

A number of organizational Table of Organization and Equipment (TOE) deficiencies are apparent in the new light engineer battalion. All staff sections were reduced in strength. The S3 was reduced over 30 percent to two officers and five enlisted and has only one vehicle. The S2 suffered a sixty percent personnel reduction to four personnel, two officers and two enlisted and retained one vehicle. The reconnaissance and engineer intelligence production and analysis capability have been significantly degraded. The battalion's communication section was reduced from

eighteen to four personnel with no officer and only one vehicle. The ability to set up and operate battalion communications on a 24 hour basis for extended periods is suspect. The assault and barrier platoon has one truck for the platoon leader but no vehicles for the two equipment section sergeants who are key to efficient equipment utilization. Brigade engineer sections have been eliminated, reducing the ability to identify and integrate engineer effort into brigade plans. The LID engineer battalion has no bridge company. Engineer and quartermaster equipment is greatly reduced with only eight cargo trucks and 16 High Mobility Multi-purpose Wheeled Vehicles (HMMWVs) in the battalion. The unit is able to transport only 2/3 of their TOE equipment in organic vehicles. There are no squad vehicles to transport tools sets, Class IV, and Class V items. The total number of available squads' man-hours has been reduced by almost 1/2 from the other engineer battalions. Each platoon now has only one vehicle, a HMMWV.

It seems apparent that the light engineer battalion organization has been stripped of all redundancy and some significant mission capability. The ability to coordinate and integrate engineer activities into brigade plans is very limited. Squad mobility has been significantly reduced, thus increasing travel time to worksites and potentially limiting availability of tools, explosives, and barrier materials. Engineer equipment has been reduced to eighteen Small Emplacement Excavators (SEE) and six Armored Combat Earthmovers (ACE). Operators are only provided for one shift operation. Maintenance operations have been centralized at battalion, where three contact maintenance trucks and one wrecker are authorized. However, no utility truck was authorized,

restricting the ability to make parts runs or transport mechanics forward for simple repairs. This brief critique of the LID Engineer battalion has identified a number of significant weaknesses that will degrade agility.

### III. HISTORICAL EXPERIENCES.

A historical example may simply be used as an EXPLANATION of an idea. Abstract discussion, after all, is very easily misunderstood.

Clausewitz, ON WAR, II, 6.

For this monograph I have selected historical experiences that demonstrate a variety of different methods used to enhance engineer unit agility. The combat arms all recognized that engineer products were critical to their success. During World War II there were no units organized identical to the current light infantry division and its organic engineer battalion. Therefore, the selection of historical experiences is limited to divisional engineers of infantry divisions, US and German, including the German Mountain Infantry Divisions (Gebirgs) and British Airborne Royal Engineers of the 1st Airborne Division. Typical US and German Infantry Division organizations are shown at table 4. The US Army operated differently in the European than in the Pacific theater. It is important to note the employment differences as well as mission similarities between theaters.

Currently, companies of the LID engineer battalion support brigades on an area basis. Examples of missions they could be called upon to perform are found during the 85th Infantry Division breakthrough at Monte Altuzzo. Company B, 310th Engineers was in direct support of the 338th Infantry Regiment. The company employed one platoon with a dozer to work on a supply trail, another platoon

cleared mines from a road and the third platoon worked on a bypass for a tank unit.(14) Since the LID engineer company only has two platoons they would need reinforcements or more time to accomplish the same missions. Therefore, increased size added to agility.

To increase engineer responsiveness it was typical to attach an engineer company to the Regimental Combat Teams. Additionally, engineers from higher commands were used to augment/reinforce the committed divisions. A good example of this is found during the battle for Schmidt when the 28th Infantry Division attached one lettered company of the 103d Engineer Combat Battalion to each of its three Regimental Combat Teams. The Division was also supported by the 1171st Engineer Combat Group consisting of three engineer combat battalions, one ponton bridge company, one trestle bridge company and a light equipment company.(15) The engineer group provided two battalions in direct support of the 112th and 110th Infantry Regiments. The remainder of the Group was in general support of the division with one battalion dedicated to road maintenance.(16) There is little mention of the exact missions of the engineer companies attached to the infantry regiments but it is reasonable to think they were instrumental in clearing lanes through the minefield on the approach to Vossenack and placing the sixty anti-tank mines in Schmidt. During the battle, it is very likely they fought as infantry, since the non-divisional engineers repeatedly fought as infantry. This battle also demonstrated the ability of engineers from echelons above division to work in and maintain the division area.

The 10th Engineer Battalion, organic to the 101st Airborne Division, provides an example of the many typical engineer missions

accomplished in the European theater of operations. These missions may be representative of those the LID engineer battalion will have to accomplish. Breaking through the German defenses of the West Wall they breached minefields, destroyed bunkers, cleared tank obstacles and blasted through wire obstacles. During the month of March 1945, the Battalion reported clearing mines from 240 miles of road, filled nine road craters, installed seven culverts, installed a 360' footbridge, constructed five bypasses, repaired three bridges, and installed five dryspan treadway bridges. Each Infantry Regiment had an engineer company attached. (17) Engineer companies were normally attached during attacks or when supporting a fast moving, fluid situation.

Operations in the Southwest Pacific Area (SWPA) were different and the combat engineer battalion proved inadequate to meet the tactical and technological requirements of warfare. (18) Part of the problem was how the organization and equipment of the combat engineer battalion were developed. Peacetime maneuvers had resulted in erroneous conclusions concerning conditions and engineer requirements on the battlefield. To make a combat engineer battalion effective a considerable amount of extra equipment had to be attached. Additionally, "The combat battalion appeared to be too small to provide adequate support for a triangular division...in fact, every division commander who served under Sixth Army was of the opinion that a minimum of two engineer combat battalions was needed for the support of one triangular infantry division". (19) Examples of engineer operations in support of infantry divisions in the South West Pacific will show that although the missions generally remained the same, changes in methods of operation were

made to attempt to correct for organizational deficiencies.

Attaching engineer companies to regimental combat teams was normally a transitory condition used only for short periods, such as during assaults and when battalion headquarters control was limited. An example is the 116th Engineer Combat Battalion of the 41st Infantry Division's support of operations on the Zamboanga Peninsula. The battalion attached a company to each Infantry Regiment during the combat landing to assist in breaching beach defenses. Mine detector teams accompanied the landing waves to clear the beaches. However, after the battalion headquarters came ashore the companies reverted to division control but still supported a regiment during ground operations. Initially, combat engineer tasks consisted of removing mines, destroying billboards with demolitions, repairing destroyed bridges, maintaining existing supply roads, providing water and the construction of combat roads. The battalion commander concluded that "if the battalion had been organized and equipped in accordance with the War Department Tables of Equipment (T/E) without benefit of the Southwest Pacific Area (SWPA) Special List of Equipment (SLOE), its equipment would have been completely inadequate for the proper support of the division".(20) Concerning command and control relationships, the commander concluded that to exploit the engineer battalion's capabilities the unit should function under division control as soon as possible after the amphibious landing.(21) With limited resources, centralized control was used to maximize output. This is the same approach being used in the LID engineer battalion.

The 77th Infantry Division report on Operation EISENBERG, Guadalcanal Campaign describes another operation that provides meaningful

insights into utilization of the divisional engineers. Engineer missions were maintenance and construction of roads, supply of water, and in general support of the advance of the infantry regiments. Engineer units in this operation also did not remain attached to landing teams, but reverted to division control upon the landing of the division headquarters. "Engineers in general were not assigned assault missions." (22) The 77th Infantry Division Commander utilized training as a means to overcome a shortage of engineers. The division commander purposely trained the infantry units of the division in elementary skills of demolition so they could assault positions without the immediate assistance of engineer troops. The only "major item of engineer equipment used in coordination with the assault was the bulldozer with armored cab." (23) A significant lesson learned from this operation, and one that had not been common practice, was to train infantrymen in demolition skills so they could assault fortified positions without engineer support. This meant the infantry was not held up for lack of engineer assault teams, nor were the limited engineer assets unnecessarily dispersed supporting the infantry. The biggest engineer problem, road construction, maintenance and repair, was handicapped by a shortage of equipment. It was found that depending on corps units to provide the necessary support was not recommended, since they were likewise unprepared to perform this function. The recommended solution was to provide more heavy equipment to the divisional engineer troops. (24) In a non-NATO contingency environment, where there will be a paucity of engineer units, we might be making the same mistake today if we think we can pass to corps engineer units the road maintenance and repair mission in the

division rear area, unless that is their sole and primary mission.

What similarities exist between theaters? First, the missions: Engineers regularly performed road clearance and minesweep operations. Engineers maintained and repaired roads, fords and bypasses. Engineers used demolitions to breach obstacles. Engineers repaired and constructed bridges. Second: Engineers found that organic engineer equipment was inadequate for the normal mission requirements. Third: That good mine detection and counter mine equipment was never available.

What differences existed between theaters? In the European Theater of Operations engineers regularly fought as infantry. Whereas in the Southwest Pacific Area, engineers were not usually committed as infantry. Divisional engineers in the European theater were often attached to the infantry regiments. In the Southwest Pacific, attachment was the exception and used only during assaults, direct support being the preferred relationship. These differences are probably a result of the greater distances, faster movements and more dispersed operations in Europe which necessitated an attached relationship. In the Pacific, centralized control was a means to maximize the work effort of limited engineer assets.

Let's look now at how the Germans organized and employed their divisional engineers. Table 4 shows a typical German infantry division of 1941. The engineer battalion had three line companies of about 200 men each. The first and second companies were partly motorized, with the 3rd company fully motorized. (25) The battalion had a "bridge train completely motorized that carried ponton and breastle equipment for about 250 feet of 9 ton bridge or about 150 feet of 18 ton bridge". (26)

During the blitzkrieg and rapid advance across France in 1940, the divisional engineers supported assault river crossings, supported the advance guard with reconnaissance and obstacle reduction, and assaulted fortifications. Having the motorized engineer company in the advance guard capitalized on their mobility and by using reconnaissance elements forward they were able to locate road blocks and devise means of getting over or around them before the main column arrived.(27) "In all cases, except possibly the one of the bridge train, the engineer units were near the heads of the columns with which they were marching".(28) The infantry unit enhanced its own agility by utilizing the mobility of the engineers in the advance guard and locating the remainder of the engineers forward in the march column to support the maneuver unit. In fact, the engineer commander was often forward, at the head of the advance guard, to prevent delays and provide a capable decision maker where he could have the greatest impact.(29)

German Mountain Divisions (Gebirgs) were organized differently than the standard infantry division. Their mission to operate in rough terrain makes them similar to the current US Light Infantry Division. Not only did the division have a semi-motorized engineer battalion, each mountain infantry regiment had an organic engineer platoon, and the high mountain battalion also had an organic engineer platoon.(30) The Gebirgs integrated engineers into the infantry units to enhance agility while maintaining a separate divisional engineer battalion to enhance the division as a whole. Engineer equipment was adapted to the rigors of the mission. Physical fitness was stressed since most equipment was carried, packed or towed through the mountains. Motorization of the

divisions' units enabled quicker deployments even in rough mountainous terrain. "Two vehicles which found approval by almost every Gebirgs unit operating in high Alpine regions were the tracked motor cycle, its manoeuvrability was very marked even in close country, and the Volkswagen light car".(31) Thus, as weapons became more lethal, fewer soldiers were needed to deliver the same or increased firepower. Improvements in motorization could get even a small number of very potent mountain soldiers into battle quickly. Motorization was a means to enhance their agility.

German engineers involved in combat in the forested terrain of Russia found themselves in a very different environment than they had experienced in France. Engineer missions on the offense were typically reconnaissance to locate enemy mine belts, determination of the mine type and then preparations for clearing paths. Engineers reinforced the infantry to eliminate strong enemy fortification and often used flamethrowers and explosives. Engineers not employed forward were used to clear obstacles on the road networks so combat, supply, and artillery vehicles could move forward. On the defense the engineers were not used to build infantry positions or fight as infantry but rather to build obstacles, abatis and wire entanglements in connection with machinegun emplacements, the latter being the most important mission in the sector.(32)

To conclude engineer unit experiences, a brief mention of the British Airborne Royal Engineers of the 1st Airborne Division is warranted. They were organized with a headquarters consisting of a field park company (airborne), a field company (airborne) and two parachute squadrons of 150 men each, consisting of a headquarters

and three troops of 40 men. The British assumption was that airborne engineers always had to be light troops. Therefore, they were equipped with only 4 jeeps and 4 three-ton lorries per squadron. "Little engineer equipment was carried and was mainly special light equipment e.g. light motorcycles, folding bicycles, light camouflage sets and light compressors".(33) The bicycles and motorcycles improved the soldiers' mobility. For the Royal Airborne engineers, training was critical. They had to make training tough and realistic in order to develop in their soldiers the ability to overcome problems in stride and to deal effectively with the difficulties of war. Engineer priorities were bridge construction, road construction and repair, demolition, and mine warfare. Additionally, they fought as infantry. As an example, the engineers who were dropped at Arnhem during operation "Market" in Holland ended up fighting as infantry.(34)

When looking at the World War II engineer experiences, it is apparent that every country took a different approach in organizing and using engineers to enhance the division's agility. I will present three other reports that bring pertinent facts to bear on the light engineer battalion organization, missions and agility.

The first is "The Infantry Conference, Report of Committee on Organization, June 1946". The committee recognized that "the reorganization of the engineer component in the infantry division in 1941 and 1942 appears to have been established on an arbitrary basis of an allowable percentage of engineers and not on an analysis of the engineer requirements".(35) That when the number of corps engineers employed on division missions is added to the divisional engineers, the actual engineer strength of the division was

approximately 3.7 percent, while the organic engineer battalion was only about 4 percent of the division's strength. The committee reported a number of conclusions, one of which states "In considering our present military requirement in the reflection of our experience in the past war, our conclusion must acknowledge that we cannot always expect to fight our major battles in the relatively favorable type of terrain that we encountered on the continent of Europe". (36) The recommendation of the board was to increase the infantry division's engineer component to a regiment of two battalions of three lettered companies plus a headquarters and services company, that included bridge assets, to give a total strength of approximately 1350. (37)

The Proceedings of Board of Officers for Review of Engineer Troop Organization, Office of the Chief of Engineers February 1970, titled " Combat Engineer Support (Divisions and Separate Brigades)" is a comprehensive review of organizational and operational concepts for divisional combat engineer units. It addresses the engineer requirements for the standard Armored/Mechanized Divisions, Infantry Division, Airmobile Division, Airborne Division, TRICAP Division, and also support of the reduced strength divisions, one of which almost mirrors the current Light Infantry Division. (38) Key elements of this report are addressed in the next chapter.

The final study that needs mentioning is the Engineer Evaluation of the Light Infantry Division (ELID), Volume I, Prepared by the Engineer Studies Center, September 1986. This is a very comprehensive study to assess "the LID's engineering capabilities and requirements under two initial combat scenarios under two different deployment and battlefield conditions". (39) The study

recommendations were significantly restricted because they adhered to the zero-sum increase rule which prohibited increases in strength or deployment sorties. Therefore, "the study recommendations do not suggest an increase in the battalion's end-strength, or to the 16 C-141 sorties required to deploy the battalion". (40) The report does provide a good, though limited, analysis of the LID engineer battalion; however, its data clearly indicates areas of capability shortfall with subsequent opportunities for greatly improved performance and agility.

#### IV. HISTORICAL ANALYSIS

Situations in history may resemble contemporary ones, but they are never exactly alike, and it is a foolish person who tries blindly to apply a purely historical solution to a contemporary problem.

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In reviewing the historical experiences of the preceding chapter, it is evident that engineers were active and important in all theaters of WW II and were organic to each participating infantry division. The missions infantry division engineers performed were similar: minesweep roads and beaches, clear lanes through minefields, engineer reconnaissance, obstacle construction and demolition, road and trail construction and maintenance, and bridge construction and repair.

In order to analyze and take the proper lessons from the historical experiences we will first return to the agility model previously developed. We can state "agility is the ability of friendly forces to act faster than the enemy...agility is as much a mental as a physical quality". (41) Friendly forces have to be able to Observe, Orient, Decide, and Act faster than the enemy. We've

already discussed these agility factors and their components. Proposed changes to the light engineer battalion must improve the ability to act faster than the enemy, as well as do more essential work.

What can we take from history on how units improved their agility? Let's examine engineer agility, first in the European Theater, in the Southwest Pacific Area, as depicted in the 1972 Engineer study, and lastly in the September 1986 ELID study.

In Europe, where the battlefield was extended, rates of advance faster, and engineer response needed to be quicker, the engineer units improved their agility primarily by decentralizing the command and control relationship, placing engineer companies "attached" to the infantry regiments. They integrated engineer groups into the divisions and kept these extra engineers busy fixing roads and bridges. Bridge assets that corps passed forward were often retained at division to improve mobility. Engineers in Europe were primarily concerned with a mobile war. Mobility was the key. Agility was enhanced by task organizing according to the situation, attempting to balance between responsiveness to the maneuver unit and to exploiting the engineers capabilities to the maximum. Staff size and composition became recognized contributors, with numerous changes made to ensure an efficient operation. It was apparent that more engineers added to force agility.

The German infantry division enhanced agility in a number of different ways. It task organized, varied commander and engineer unit location in the march column, employed active reconnaissance and maximized the use of limited mobility assets. Agility was enhanced by placing highly mobile, motorized engineers in the

advance guard. The remainder of the engineer battalion followed near the head of the divisional march column. The engineer battalion commander was often forward with the advance guard where his decisions insured the continued movement of the infantry division. The infantry engineer battalion had the third largest number of motorcycles per unit, falling behind only the Reconnaissance battalion and Anti-Tank battalion. Enhanced mobility was important to the German engineers. With German motorized engineers forward in the advance guard, reconnaissance became a primary mission. On some occasions engineer reconnaissance teams checked as far as fifty miles on each side of a major river crossing site to find local materials and existing crossing assets. (42) Since the LID engineer battalion plans to use captured and indigenous materials, it is important they have a reconnaissance capability that is up to the task. Reconnaissance allows the engineer to know the area of operations. German Mountain Infantry Divisions enhanced their agility by making engineer platoons organic to their mountain infantry regiments.

In the Southwest Pacific Area with conditions vastly different than in Europe, the combat engineer organization was clearly deficient. The size and composition of the force in relationship to the work load was a significant factor in determining engineer agility. Narrower frontages, slower rates of advance, and fewer engineer reinforcements from corps led to centralized command. Centralized command stressed the staff's ability to integrate additional engineer assets and the preferred relationship became "direct or general support" with command centralized at division. Thus, limited assets required measures to maximize engineer output

and centralized command and control was the method used to improve agility. This is the same situation currently facing the LID engineer and doctrinally we have adopted the same answer.

It is safe to say that the size of the divisional engineers in the WW II US Army was felt to be inadequate, hence the 1946 Infantry Board's recommendation to increase the size of the divisional engineer force. It was recognized that a bigger force added capability and agility. Centralized control of bridge assets by corps was a slow, cumbersome, but workable system used during the war. The 1946 Infantry Board felt that improvements could be made and recommended placing limited bridge assets organic to each infantry division. (43)

From these examples what are some of the factors affecting agility? It is obvious that mobility, command and control relationships (attached, direct or general support), staff and force size, organizational structure, missions, nature of the terrain, size and fluidity of the battlefield, available equipment (organic or attached), training, reconnaissance capability, commander location, and integration into the combined arms team are all factors that affect agility.

There were three reasons that the engineer units were organized and integrated so poorly into U.S. divisions. First, organizations and equipment were the result of peacetime maneuvers that minimized both the construction requirements and the obstacle and mine removal missions. (44) The following quote describes peacetime exercises that were used to form the basis for engineer force structure. It may be applicable today.

"Training exercises of infantry divisions were, however, conducted under conditions where the availability of facilities

made engineer work largely unnecessary. For example, little road construction was required during maneuvers in the United States because extensive highway systems were readily available. It was not necessary to rebuild bridges since none were destroyed. Peacetime tests could thus easily become a basis for error in determining the troops and equipment required for engineer units." (45)

Second, branch proponents clung to traditional doctrinal employment, refusing to entertain changes in both organization or employment. (46) Third, reorganizations in 1941 and 1942 had been made on an arbitrary basis of an allowable percentage of engineers and not on an analysis of the engineer requirements. (47) It appears that some of the same organizational nearsightedness occurred when organizing the LID engineer battalion.

Let's examine the 1972 Vietnam era Combat Engineer Support study that drew upon the wisdom of wartime experienced commanders as board members and additionally sent a questionnaire to selected engineer and non-engineer general officers to solicit input from experienced field officers. (48) The study group attempted to take advantage of the immediate lessons learned from the Vietnam war and with an integrated approach, design divisional engineer battalions that could meet the demands of future conflicts while building on the lessons of war.

One of the major proposals in the above study was a requirement for four companies in the engineer battalion. This would allow one company to support each maneuver brigade and a company to support the remaining division troops and artillery. The validity and merit of the idea of four line companies had been previously recognized and recommended in the engineer reorganization of 1942 but had not been accepted for a number of seemingly insignificant reasons. (49) The 1972 study proposed a heavy and light company building block

concept. Airmobile engineer equipment was recommended for the light engineer company. The different divisional engineer battalions were composed of a mix of heavy and light engineer companies. However, the airborne, airmobile and reduced strength infantry division were composed totally of the light engineer companies. The 1972 General Engineer Support study proposed an engineer battalion organization to support a 10,000 man reduced strength infantry division. This engineer battalion structure is shown at figure 2. In the reduced strength infantry division the engineer battalion retained four companies to maintain a general support capability while retaining the flexibility to reinforce a Direct Support company as required. The companies were reduced to only two platoons each, with three reduced strength squads in each platoon. It was recognized "that scaled down engineer battalions are not capable of sustained operation without substantial reinforcement". (50)

In addition to the four company concept, other significant changes were recommended, some of which were a move to airmobile equipment, the addition of a squad machine gun, a requirement for two chain saws per squad, and retention of enough vehicles to keep the companies 100% mobile. Recognized areas that needed improvement were equipment to detect and breach mines and minefields, new mine emplacement methods and the development of scatterable mines. The new mines are now a reality but no major improvements have been fielded in the mine detection and minefield breaching arena although a number of proposals were cited and expected to be fielded in late 1970s, early 1980s timeframe. (51) Countermine operations continue to be a major shortcoming in the US Army.

The last major document which reviews and analyzes light

engineer agility is the September 1986, Engineer Analysis of the Light Infantry Division (ELID). This is the first major report to document and compare engineer work requirements to capabilities in two different scenarios, one Latin American and the other European. The study identifies engineer work requirements in both squad man-hours and equipment man-hours and prioritizes them as vital, critical, essential, and necessary. A summary of the priority groups and consolidated increment priority list is shown at tables 5 and 6. Capabilities were balanced against requirements to identify shortfalls or excesses in both squad man-hours and equipment hours. This attempt to balance work requirements against available engineer capability is a critical step in creating a viable engineer organization that has the ability and ability to support the LID. The study is important because it attempts to balance the engineer types and squad man-hours to insure that engineers either organic or from echelons above division have the capability to accomplish the required missions. The Latin American scenario squad man-hour and equipment hour requirements and shortfalls indicate the magnitude of the problem facing the LID engineer battalion. These calculations are shown at figures 3 and 4. (52)

The ELID study not only analyzed equipment hours but also equipment mix. An equipment imbalance was apparent. "The LID engineer battalion needs 1.5 to 3 times as many Armored Combat Earthmover (ACE)-hours as Small Emplacement Excavator (SEE)-hours to meet requirements generated during the... scenario." However, TCE authorizes 18 SEEs and only 6 ACEs, an almost total reversal of the requirement. (57)

A major underestimate of engineer squad-hours was built into

this study by the selection of obstacles. Obstacles emplaced were limited to minefields, tank ditches, road craters, abatis, and bridge demolition. No barbed wire was planned or emplaced. The failure to use barbed wire as an obstacle and almost total reliance on mines appears to be a significant shortcoming. Barbed wire may be manpower intensive, but it has proven its effectiveness repeatedly during both World Wars and in Vietnam. The emplacement of barbed wire to create fire channels for machine gun positions was a priority engineer effort for the German engineers in the forests of Russia. (54) History shows that mines by themselves are not effective in stopping a concerted infantry attack. Although US forces received significant mine casualties during their attack on Vossenack during the battle of Schmidt, they were able to continue and successfully seize their objective. Comments by an Argentinean officer during the Falklands war are enlightening. "You have just walked through my minefield" were his words to the British officer capturing him. (55) The British received no mine casualties during this particular operation. Mines are valuable as an obstacle but total reliance on their ability to delay, disrupt or stop the enemy at the expense of other obstacles, particularly barbed wire, is a dangerous proposition. The underestimate of squad-hours resulting from the obstacle selection is a major deficiency in the study.

The study identifies major weaknesses in the light engineer battalion structure when balancing work requirements against unit capabilities. There are other structural deficiencies, in addition to equipment mix and a shortage of squads. Some of these were identified in the observer's doctrine. Since the 11th conducts reinforcement from a corps engineer battalion, a good question is:

"Does the LID engineer battalion have the agility and capability to efficiently employ additional corps assets?". I think not. Any agility improvements must upgrade the capability to quickly and efficiently utilize reinforcements that may be pushed down from higher.

The ELID study places a reliance on corps engineer units to accomplish the excess work requirements that exist. This has been a valid historical method. However, in the proposed scenarios the airframes to deploy the corps engineers are in direct competition with other divisional units. The divisional engineer is able to accomplish the vital and critical missions upon which the success or defeat of the force pivots. But the ability to defer major portions of squad labor intensive work may have long term negative effects on the force. What happens if the corps engineer units are not available, since the proposed units to provide the work effort are currently not in existence?(56) Reinforcement of the LID is only one of the missions currently assigned to the corps airborne engineer battalion. There is no assurance they will be available to dedicate their efforts to the LID.

A sensitivity analysis was conducted as a part of the ELID study with test cases being the addition of a third platoon per company and the addition of a fourth company in the Battalion. None of these measures served to reduce the major backlog of squad-hours. However, neither of these proposals could be recommended because they were outside the fundamental assumption: no increases in strength or C-141 sorties.(57) This shortsightedness and strict adherence to a strength ceiling as either a number or percent again seems to be a major weakness in the study and

resembles one of the problems identified by the Infantry Board of 1946.

## V. RECOMMENDATIONS

Conceptions based upon historical experience do not necessarily guarantee success in the field.

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Perspective on Military  
History.

What then can be done to improve agility? Identifying and developing a rank-ordered list of recommendations that will increase agility at the least cost in strategic deployability is essential. Let's first examine the light engineer battalion force components that will improve agility: force size, organization, structure, missions it's responsible for (pass others to EAB), equipment, communications capability, mobility, training, employment roles (attached, opcon, DS, GS), and integration into the combined arms team.

Some component areas that have been addressed by others, to include the 10th Engineer Battalion, and are perceived as relative optimized are: training (unit training), number of radios (per the ELID report), physical fitness, soldier skills (sapper and sapper leader) and support relationships. The move to centralized control, attempting to maximize output of the limited engineer resource, has been made, but at the expense of responsiveness to the maneuver battalion and brigade commanders.

The first recommendation concerns two aspects of training techniques employed by the Royal Airborne Engineers in WWII. Since LID engineers like airborne engineers won't get the opportunity to see and study their objective before they get there, the use of large sand tables should become mandatory. Using sand tables

provides soldiers the opportunity to get a visual feel for the ground before they arrive. Once on the ground there is little or no time to waste getting a terrain orientation. The time spent preparing, teaching and training on a sand table will be repaid in quicker responses on the ground. The second part of training is conducting REALISTIC training. Training should approximate battle conditions. Soldiers need to be taught the ability of overcoming problems in stride, including utilizing and improvising with local materials, using any means available to accomplish the mission. IEP The SAPPER school is attempting to accomplish this but it must be continually reinforced in the unit during all training exercises.

Second, ensure the engineer battalion command and control systems and SCRs are efficient and integrated into the division or brigade operations. This recommendation is really only a restatement of one of the factors of agility stated in the Light Infantry Division Operations manual but it is one that needs to be reviewed, practiced and checked regularly.

Third, upgrade the battalion S2. Improvements are needed in the ability to observe the battlefield. The LID engineer battalion plans to maximize the use of local materials and construction equipment. Before it can use local materials and equipment it must find them, and this means adding a meaningful reconnaissance capability to the battalion S-2. The reconnaissance teams must be mobile with a minimum of two people each so measurements can be taken at bridges, fords and other obstacles. The Combat Engineer Support study recommended two teams and that seems appropriate. The recon teams need a highly mobile vehicle to get around the area of operation. The Germans found the motorcycle very useful but it is

not amphibious, not great in mud or really rough terrain and normally is a one person vehicle. A suitable alternative is the four wheel all terrain vehicle (ATV). This machine has the capability to carry equipment and two people, can negotiate essentially any terrain and can float or swim water obstacles. Reconnaissance teams must be able to communicate so a radio per team is also required. The third recommendation increases the agility factor of observe by enhancing the battalion S2 with the addition of two recon NCOs, two drivers, two radios and two 4-wheel ATVs.

The fourth recommendation is to add three Brigade engineer sections. These sections will increase the ability to orient and integrate the engineer effort into the maneuver brigade's plan. Addition of a brigade engineer staff element is critical to the timely, orderly, efficient, and effective integration of not only the divisional engineer effort but the efforts of the engineer battalion from corps. Timely integration of engineer considerations into the planning effort at the brigade level will significantly enhance responsiveness and maximize utilization of limited engineer resources. This staff section could be similar to other divisional elements and in an unconstrained environment the recommendation would be to add an officer and three enlisted plus a BMWV and radio. However, the recommendation for minimum staffing is one officer, O-3 or O-4 and an operations NCO to ensure continuity and a twenty-four hour capability. The Brigade engineer should be equipped with an all terrain vehicle (ATV) because of its mobility, small size, yet inherent load carrying capacity. The designers of the combat engineer battalions organic to the Airborne Air Assault Divisions 86, recognized and kept the Brigade engineer sections. (59)

This brigade engineer section directly adds to both engineer and force agility.

The fifth recommendation is to upgrade the battalion communications section by adding an officer and two additional vehicles. The officer is needed to handle classified communications security equipment and codes, organize, plan and exercise the battalion communication requirements. These requirements are beyond the capability of the enlisted men in the section. Additionally, a requirement exists to transmit record and hard copy messages and overlays between headquarters and subordinate units. If a rugged, reliable, modern, high technology system exists that can accomplish this requirement it should be added to the TCE. Previous engineer organizations used couriers and motorcycles, as can be seen in Table 2. These organizations had six motorcycles in their communication sections. Without a more modern system, motorcycles and couriers can provide service to all echelons and support not only the communications section, but all sections in the battalion headquarters. Because of the reduced requirements and distances in the division area of operations and the possibility of a high technology fix, only two motorcycles with commo drivers should be added to assist the accomplishment of routine communication requirements.

The next recommendation is to add a squad tool vehicle and chain saws. This one vehicle will increase platoon and squad mobility with subsequent improvements in the capability to act. Engineer squads use tools to accomplish their missions. It follows they must have tools readily available at each job site. I know no problems with how this is currently done. At present there is no

one vehicle in each platoon to carry the platoon tools and squad tools. This vehicle also serves as the platoon leader's and platoon sergeant's vehicle, is used to perform reconnaissances of future work sites, carries materials and resupplies the platoon's needs. This vehicle is overcommitted and cannot efficiently carry all the tools, sets, mine detectors, chainsaws and personnel in the platoon headquarters. Using the technique of a mobile tool dump, much like the engineers during the battle of Schmidt established a centralized tool dump, (60) each platoon should have assigned one HMMWV to carry all the squad tools and also serve as the platoon sergeant's vehicle. The addition of this vehicle to carry squad tools will allow more efficient utilization of the platoon leader's vehicle and, at the same time, ensure the squad tools are available when needed. Using the squad tool vehicle for mobility, the platoon sergeant will have the capability to actively supervise, coordinate and support each squad at separate work sites.

Additionally, each squad should be equipped with at least one chain saw. The chainsaw, as a single engineer piece of equipment, was a specific item of importance in the Combat Engineer Support study. The chainsaw enhanced squad performance of mobility, counter-mobility and survivability missions that utilized native timber. Construction of overhead cover, command bunkers, revetments, culverts, log posts, and a host of other fortifications requires the use of chainsaws. In the likely areas of deployment, timber may be one of the few natural resources available. The chainsaw may be one item not used in training because of restrictions on cutting to one, but it must always be available in likely areas of operation. Thus, the sixth recommendation with

the addition of one HMMWV and three chainsaws per platoon enhances agility by improving the ability of the squads to accomplish the mission.

The seventh recommendation adds one HMMWV utility truck to support both the S4 and the maintenance section. Neither section currently has a utility truck. The maintenance section currently has twenty-five personnel and only one cargo truck. This truck with trailer are fully committed carrying the unit maintenance and repair kits, mechanics tool boxes and prescribed load list items. With maintenance consolidated at battalion, the maintenance section needs a vehicle to make parts supply runs, and carry mechanics to field locations to conduct on-site repairs. The section is also authorized three contact maintenance trucks. This seems excessive based on the number of vehicles in the battalion. An additional part of this recommendation would be the deletion of one contact maintenance truck. Summarizing, the seventh recommendation adds a HMMWV and deletes a contact maintenance truck and should increase maintenance capability and logistics coordination which are essential for unit sustainment.

The next two recommendations to change equipment mix and improve mine capability are identified by the ELID study and improve the ability to perform specific missions. The equipment mix of ACEs and SEEs should be changed to 11 ACEs and 10 SEEs. This improves the work load balance between types of equipment without increasing the required C-141 sorties. Additionally, the "battalion SEEs should be configured with loader, backhoe, and auger attachment...the handtool allotment for all SEEs in one C-141 should be authorized the auger handtool".(61) The second ELID

recommendation is the employment of scatterable mining systems to enhance timely installation of minefields and reduce a labor intensive mission. The recommendation is that "the LID should improve its operational performance, provide logistical savings, and reduce manhour requirements by procuring the NATO Improved Conventional Mine (ICOM) (which is available now) or developing a US version of the NATO ICOM immediately".(62)

The tenth recommendation adds a fourth engineer company and is a major improvement to the current organization. Addition of a fourth company is founded in recommendations for organizational improvements during WW II, the 1972 Combat Engineer Support study and the sensitivity analysis used in ELID. It is about time the importance of a fourth engineer company be recognized. The fourth company improves overall engineer agility and will significantly enhance the LID engineers' ability to meet work requirements identified in the ELID scenarios. The fourth engineer company should be organized with two platoons of three squads each. This recommendation adds sixty-three personnel, one cargo truck, and five HMMWVs to the battalion, little more than one C-141 sortie. The fourth company significantly increases engineer agility, flexibility and capability to meet known, identified mission requirements as well as reacting to unknown situations.

The eleventh recommendation adds two equipment section sergeants vehicles, HMMWV, and radios. Currently the assault and barrier platoon has only one vehicle, for the platoon leader. The equipment, ACEs and SEEs, operating in different locations the responsible NCOs have no mean to supervise and coordinate their operators. Shuttling operators, parts, mechanics, food and fuel

will be possible with the addition of HMMWVs and radios for the two section sergeants. Enhanced, timely equipment operation and utilization, from very limited assets, is the desired result from this recommendation.

The twelfth recommendation would add a liaison vehicle and radio to the battalion S3. Currently the S3 has only one vehicle that is used for the multitude of activities the S3 must accomplish. Coordination and integration of the engineer effort is essential for proper support. A vehicle, either motorcycle or ATV, will allow the S3 to check mission sites, coordinate requirements and send his staff as needed to make face-to-face and on-site visits. The addition of the ATV better meets the needs of section and will enhance the ability to observe, orient and decide, all essential to improving agility.

The thirteenth recommendation provides squad vehicles for a minimum of one company and preferably all the squads in the battalion. This vehicle increases the mobility of the squad, reduces travel time between work sites, provides a means to transport Class IV and Class V materials to support the engineer unit missions and reduces the fatigue of the engineer soldier. He now walks to each mission site and then accomplishes the physically demanding engineer missions. It won't take many days of intense engineer work to "burn out" engineer soldiers. The squad vehicle that carries troops and tools should double as an earth or logistics hauler. By performing multiple tasks, the vehicle results in a real economy of effort when supporting engineer sustainment missions. Addition of a squad vehicle, be it a HMMWV, airmobile 2 1/2 ton cargo truck, 2 1/2 or 5 ton cargo truck or a 5 ton dump truck, will

improve the squads' mobility and thus their ability to accomplish their missions. A motorized squad becomes a more responsive, capable unit able to move quickly around the battlefield. With a squad vehicle, engineers can move their effects around the battlefield quickly and with sufficient material to do major work. No longer will the engineer be foot mobile or tied to the scarce Blackhawk helicopter for mobility throughout the area of operation. If motorization of all the battalion squads is not possible then one company should be fully motorized in the same fashion that the German Infantry Division's engineer battalion had one company fully motorized. This addition would greatly enhance the engineers' mobility and thus agility. In all the platoons where a squad vehicle is provided the recommendation for a platoon tool vehicle would be withdrawn and an ATV provided to the platoon sergeant for mobility.

The above thirteen recommendations are prioritized to minimize the impact on strategic deployability while enhancing engineer agility. The recommendations are summarized in table 7. If any were to be forfeited it should be the addition of squad vehicles for the complete battalion. A minimum of one company should be motorized. Although the last recommendation has been proposed by others in the field and is under active consideration as a change to the TCE, it does not incrementally increase the engineer's agility in proportion to the cost and impact on strategic deployability. These recommendations attempt to focus on improvements to agility (the ability to think and act faster than the enemy). Some ideas are new, some old. None have addressed the use of night vision devices, remote firing devices, or exotic explosives, but have

instead focussed on more traditional measures to enhance agility. No attempt was made to recreate a standard 782 man infantry division engineer battalion. Plans to upgrade firepower, however nice, do not add to engineer agility and were not addressed. Agility for the engineer means increasing the combat effectiveness of the light infantry division in a timely, responsive, flexible, and integrated manner.

## VI. CONCLUSION.

"Like this cup,"..."you are full of your own ideas and speculations. How can I show you Zen unless you first empty your cup?"

Musashi, THE BOOK OF FIVE RINGS.

Agility has both mental and physical qualities. The 13th Engineer Battalion, as the oldest and most experienced LID engineer battalion, has certainly enhanced its agility through the only means available. With tough, demanding, and rigorous training, new innovative ways to accomplish missions, centralization of control, the 13th Engineer Battalion has taken actions to increase capability, responsiveness, and agility.(63) The training base has supported the LID with both the SAPPER and the Sapper Leader Courses.(64)

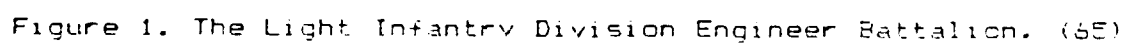
The Engineer Analysis of the Light Infantry Division study identifies squad-hour and equipment requirements for two likely scenarios. The study also quantifies the squad-hour shortfall in an attempt to identify requirements for the Echelon Above Division support that must follow quickly if the LID is to survive. Equipment types and mix were evaluated and improvements identified and recommended. However, the study misses the central issue of improving the engineers' agility. It takes the traditional approach

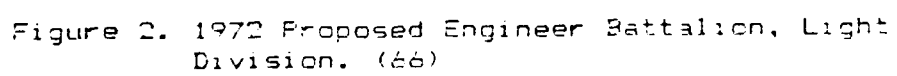
of balancing work and capability to find out how many more engineers are needed. This is not necessarily the best or most efficient way to improve the light engineer battalion.

The current LID engineer battalion is not a robust organization. It lacks the size, equipment, redundancy, flexibility, mobility, and, yes, agility to provide the engineer support the light infantry division requires and rightfully should expect. Adding equipment and personnel blindly and in piecemeal fashion will not increase agility and remedy the inherent problems. Relying on Echelon Above Division engineers to provide manpower and equipment support will not meet or solve the inherent needs of the LID. Organizational changes must be made first within the LID engineer battalion if the additional engineer effort available from a corps engineer battalion is to be put to productive use. The thirteen recommendations in this paper attempt to increase engineer agility. With an agile, responsive force, additional engineer effort can be focused where it is needed most. Otherwise, it will be scattered in shotgun fashion throughout the division area, with only a small chance of being employed in the most critical areas.

Improvements to the engineer force and the LID engineer battalion will not happen by chance. How the functional mission areas are accomplished, the equipment required, personnel strengths needed, and the compromises made between best and affordable organizational structure are all issues that must be studied, examined, objectively evaluated, and tried. Arbitrarily limiting an organization to 290 personnel and 16 C-141 sorties is the modern equivalent of the narrow thought that restricted engineer force development in WW II. It doesn't make sense to dedicate over 50

C-141 sorties to the corps engineer unit but not provide the divisional battalion the fundamental assets, capabilities and agility to accomplish its missions or properly integrate the efforts of the corps supporting battalion. If airflow requirements are a zero sum game, then the required corps engineer battalion, that will also be airlifted into theater and is now recognized as absolutely critical to engineer mission accomplishment and LID survival, should be added to and balanced with the divisional engineer requirement. To limit one at the expense of both is folly. Plan and mental agility without physical capability are worthless. The thirteen recommendations will improve engineer agility and must be made if the light infantry division's engineer battalion is ever to approach its potential.





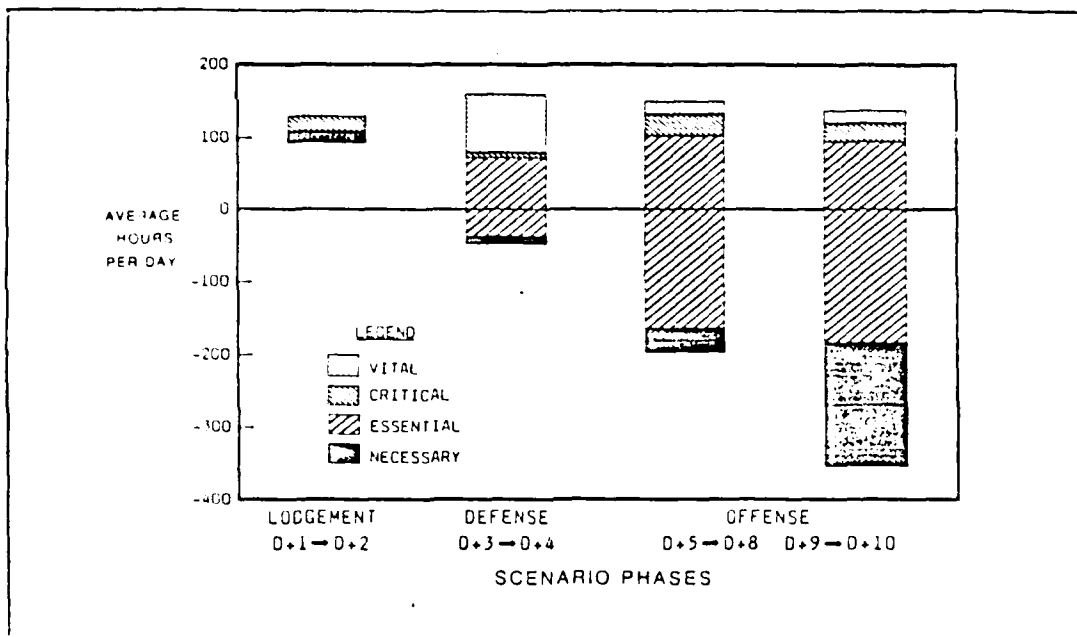


Figure 3. Latin American Base Case Capability vs Requirements (Squad-Hours) (67)

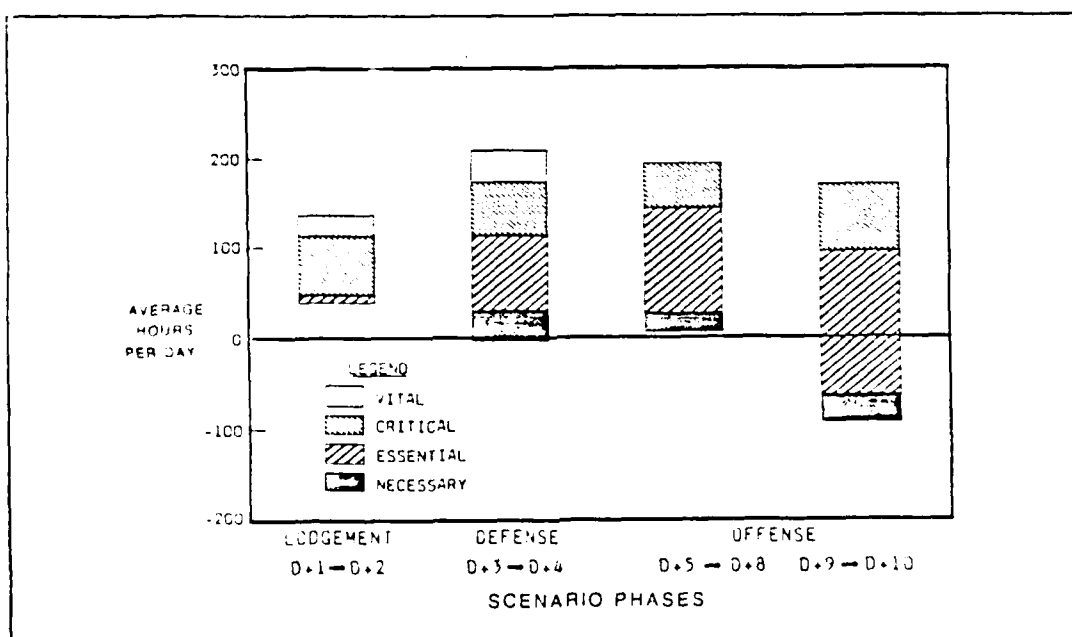


Figure 4. Latin American Base Case Capability vs Requirements (Equipment-Hours) (68)

Table 1.  
COMPARISON OF LIGHT AND MECHANIZED DIVISION ENGINEER BATTALIONS (69)

ORGANIZATION (Tt1//Off//WO/EM)	Engr Bn (Armored/Mech Div) (TOE 5-145J)	Engr Bn (Inf Div) (TOE 5-155H)	Engr Bn (Inf Div Lt) (TOE 5-155L)
En	1028//50/8/970	823//38/3/782	314//25/1/286
HHC	139//17/3/119	125//13/1/111	125//13/1/111
Div Engr Sec	5//2/0/3	5//2/0/3	5//2/0/3
Bde Engr Sec (1/3de-3 total)	4//1/0/3	4//1/0/3	0//0/0/0
S3 Sec	10//2/0/8	12//2/0/10	7//2/0/5
S2 Sec	12//2/0/10	10//2/0/8	4//2/0/2
Commo Sec	7//1/0/5	13//1/0/17	4//0/0/3
Combat Engineer Companies	4/Bn 135//7/1/177	3/Bn 164//5/0/159	3/Bn 63//4/0/59
Combat Engineer platoons	3/Co 32//1/0/31	3/Co 41//1/0/40	2/Co 27//1/0/25
Combat Engineer Squads	3/Plt 8//0/0/8	3/Plt 11//0/0/11	3/Plt 3//0/0/3
Vehicles	M113 APC	5 ton Dump Tr	none

Table 2.  
COMPARISON OF LIGHT AND MECHANIZED DIVISION ENGINEER BATTALIONS (70)

	Engr Bn (Armored/Mech Div) (TCE 5-145J)	Engr Bn (Inf Div) (TCE 5-155H)	Engr Bn (Inf Div Lt) (TCE 5-155L)
Combat Engineer Co	4	3	3
Bridge Company	1	1	0
Antitank Guided Missile Weapons	24	18	0
Armored Combat Earthmovers (ACE)	25	19	6
Armored Personnel Carrier	48	0	0
Armored Vehicle Launched Bridge	16	6	0
Combat Engineer Veh	3	3	0
Command Post Carrier (M577)	7	0	0
Crane (20 ton)	2	3	0
Dump Truck 5 T	32	45	0
Ground Emplaced Mine Scattering Syst.	4	3	0
Machine Gun Hvy flex	74	6	0
Machine Gun Lt flex	135	25	12
Recovery Vehicle (M88)	4	1	0
Road Grader	0	4	0
Scoop Loader	4	5	0
Small Emplacement Excavator (SEE)	8	30	18
Truck Cargo 2 1/2T & 5T	56	24	8
Truck Utility 1/4T & HMMWV	55	34	15
Motorcycle	6	6	0

Table 3. Divisional Unit Strength Comparison.

US Army Infantry Division H series (71)		
Unit	Personnel strength	% of division total
Div Hq	139	.00
Sde Hq (C)	318	1.66
Inf Bn (Mech)	897	4.69
Tank Bn	518	2.71
Inf Bn (8)	3400	33.46
Divartv	2824	15.26
Air Cav Sqn	782	4.69
Cbt Avn Bn	1154	6.03
ADA Bn	839	4.39
Engr Bn	325	4.31
MP Co	206	1.08
Sig Bn	767	4.11
Cml Co	155	.81
MI Bn	619	3.24
Discom	2515	17.15
TOTAL	12123	

US Army Infantry Division Light 1986 L series (72)		
Unit	Personnel strength	% of division total
Div Hq	206	1.71
Inf Sde	1777	16.51
Inf Sde	1777	16.51
Inf Sde	1777	16.51
Divartv	1356	12.60
CAB	1041	9.67
ADA Bn	323	3.00
Engr Bn	314	2.92
MP Co	77	.72
Sig Bn	470	4.37
MI Bn	295	2.71
Discom	1349	12.57
Div Band		
TOTAL	10742	

Table 4. Divisional Unit Strength Comparison.

German Army Infantry Division 1941 (73)		
Unit	Personnel strength	% division total
Div Hq	158	1.92
Rec Bn	625	3.63
Inf Regt	3250	18.90
Inf Regt	3250	18.90
Inf Regt	3250	18.90
Arty Regt	3500	14.57
AT Bn	550	3.23
Engr Bn	843	4.90
Sig Bn	474	2.75
Div Serv	2300	13.37
TOTAL	17200	
US Army Infantry Division July 1943 (71)		
Unit	Personnel strength	% division total
Div Hq	149	1.09
Cav Recon Trp	155	1.13
Inf Regt	3118	22.78
Inf Regt	3118	22.78
Inf Regt	3118	22.78
Div Arty	2150	15.78
Engr Bn	647	4.73
Med Bn	465	3.40
Special Troops	753	5.54
TOTAL	13688	

Table 5. Priority Groups (75)

Short Title	Implications of Nonsupport
Vital	Jeopardizes the existence of the division; high loss of life; and early defeat of the division.
Critical	Failure of division operations; increased probability of defeat; paramount to success in pivotal situations.
Essential	Short-term degradation in sustainability; significant equipment and material losses (may be deferred 1 to 2 weeks).
Necessary	Long-term degradation in sustainability; moderate equipment and material losses (may be deferred up to 4 weeks).

Table 6.. Consolidated increment priority list -- Latin American Scenario (76)

Rank	Priority Group	Battle Phase		
		Lodgement	Offense	Defense
1	Vital	G-1	M-1	S-1
2	Vital	S-1	C-1	C-2
3	Vital/Critical	(V)M-1	(C)S-1	(V)G-1
4	Vital/Critical	(V)G-1	(C)M-2	(V)C-1
5	Vital/Critical	(V)S-2	(C)G-1	(C)S-2
6	Critical	M-2	G-2	S-3
7	Critical	S-3	S-2	G-2
8	Critical/Essential	(C)G-3	(E)M-3	(E)C-3
9	Essential	S-4	M-4	G-3
10	Essential	C-2	S-3	M-2
11	Essential	G-4	G-3	C-4
12	Essential/Necessary	(E)C-3	(N)C-2	(E)S-4
13	Necessary	M-3	G-4	G-4
14	Necessary	C-1	S-4	M-1
15	Necessary	M-4	C-3	M-3
16	Necessary	C-4	C-4	M-1

\*Ranked by increment level (letters indicate engineer mission areas): M= Mobility; C= Countermobility; S= Survivability; G= General Engineering.

Table 7. Summary of Recommendations-  
Personnel and Equipment Changes.

	Personnel			Equipment			
	Total	Off	WO/EM	Rdo/	Cgo	Trks/	HMMWV/ Mtrovcs/ ATV
TOE 5-155L							
Bn Base	314	25	1/288	55	8	15	0
<hr/>							
Recommendation #							
Short title							
1. Training	N/C						
2. SOP	N/C						
3. Reconnaissance	+4			+2			+2
4. Brigade Engr	+3	+3		+3			+2
5. Communication	+1	+2					+2
6. Squad						+5	+13 (100M) (100M)
7. Maintenance				-1	maint	trk	+1
8. Equipment mix						(+5 ACE -8 SEE)	
9. Mines						purchase scatterable mines.	100M
10. Fourth Co.	+4	+59		+4	+1		+3
11. Asslt & Bar.		+2		+2			+2
12. SC Operations				+1			+1
13. Squad Mobility						min +60	min -2
(assumes Bn of 4 companies)						max +240	max -8
Recommend airmobile dump truck						2 1/2T or 5T	max +3
<hr/>							
Total Implementation							
	Personnel			Equipment			
	Total	Off	WO/EM	Rdo/	Cgo	Trks/	HMMWV/ Mtrovcs/ ATV
Change	+78	+8	0/+70	+12	+1	+12	+2
					-1	+ 60	+140
						(maint trk)	
						dump trk min+60	(+24 chassis)
						max+240	
<hr/>							
*one company motorized							
@four companies motorized							

#### ENDNOTES

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